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SPIN-OFF BENEFITS OF SPACE TECHNOLOGY

Working paper submitted by China

China's space programme began in the 1960s. As the space programme has evolved, there has been an ever greater demand for new technologies, new materials, new sources of energy and new equipment. Accordingly, proceeding from the principle of self-reliance, China has identified corresponding projects for study by many of its scientific research and manufacturing establishments, thus greatly promoting development and progress in many fields, e.g., materials, electronics, machinery, chemicals and metallurgy. Over 4,000 projects inspired by developments in space technology have now been completed in such areas as computers, integrated circuits, lasers, optical fibres, high-temperature alloys, titanium alloys, new composites and rare gases. This has not only ensured the successful implementation of China's space programme, but also gives impetus to the development of China's high-tech manufacturing industry. China's space technology consists primarily of control technology, temperature-control technology, telemetry and remote-control technology, remote-sensing technology, radio technology, space environment simulation technology and measurement technology. Achievements in hundreds of projects employing these technologies have been applied in traditional manufacturing industries, yielding immense economic benefits. Thus, the development of space technology in China has not only had direct benefits for various sectors of the national economy in such areas as communications and remote sensing, but has significant spin-off benefits as well.

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I. EXTENDING SPACE TECHNOLOGY APPLICATIONS

Various space technologies have been adapted for extensive use in the following areas:

1. Industrial automated measurement and control technology

The Chinese Academy of Space Technology (CAST) has successfully developed the STD5000-series industrial controller, developed and produced nearly 100 different modules, and developed over 20 software packages, which have wide-ranging applications in various industrial systems.

China's aerospace agencies have developed an interface standard for computer-based automated measurement and control (CAMAC), and have developed and produced more than 100 different functional modules, which in various combinations have potential applications in many areas. In particular, they have been used effectively in power-grid measurement and control in power stations.

Because satellite-borne computers must have long life and high reliability, error-tolerant and self-adapting technology is employed. An error-tolerant measurement and control system based on three computers has been developed which has been used in production lines in oil refineries, water-supply plants and breweries.

Radio telemetry and remote-control technology along with data collection and control technology developed on the basis of satellite-borne computer technology have now been extended to applications in oilfields and oceanographic buoys.

Industrial controllers for robot welders developed from computer and control technology have found applications in production assembly lines.

2. Development and application of remote-sensing and electronics technologies

A medical X-ray television system has been developed using remote-sensing imaging technology and electronics technology. This system has the advantage of low radiation damage and high resolution, and is well suited to clinical diagnosis. It is now in use in many hospitals both in China and abroad.

A train-axle thermal radiation detector has been developed using satellite infrared detection technology. It can quickly determine train-axle temperatures over a wide range, providing very effective early warning of failure. This detector is now widely used in railway systems.

Remote-sensing equipment and image-processing technology developed for satellite remote sensing are being employed in aviation, achieving good

results in resource and oceanographic surveying, disaster monitoring and forecasting, crop-yield prediction, etc.

3. Development and application of temperature-control and vacuum technologies

By the late 1970s, satellite temperature-control technology was already being used in the development and utilization of solar energy and energy conservation. Much technical experience has been gained in cold storage and temperature-control architectural design.

The heat-pipe technology used in satellite temperature control has been used on the ground since the late 1970s. A variety of products - heat-pipe thermal exchangers, heat-pipe black bodies, heat-pipe thermostats, heat-pipe solar collectors and heat-pipe energy-saving boilers - have been developed. These products are used extensively in the electronics, instrumentation, textile, chemical, casting, boiler-making and other industries as well as in everyday life.

The magnetic coupling and drive technology developed from satellite component vacuum testing technology offers the advantage of good sealing, no leakage and an appropriate transmission torque. It is therefore widely used in the petroleum, chemical, atomic energy, hospital and food-processing sectors.

II. PROCESSING TECHNOLOGIES AND OTHER NEW TECHNOLOGIES IN THE SPACE INDUSTRY

1. Processing technologies

Ion-beam etching is an ultra-precision processing technology developed for the processing of space materials. This technology has the advantage of producing etched patterns with extremely high resolution, controllable groove-depth and groove-wall inclination, and low surface stress. It has become an effective tool in China for the research and production of many new devices, such as large-scale integrated circuits, acoustic surface-wave devices, magnetic bubble devices, microwave devices and superconducting devices.

Aerospace precision processing technology and computer-based automated manufacturing technology have been employed in the processing of high-precision, fine-finish equipment, such as electron accelerators for medical use, moulds for camera lenses, and magnetic drums for video recorders.

2. Extending the application of new technologies

Adapting the new processing technologies that have been developed for space manufacturing to other industries will result in a vast improvement over existing technologies. Technologies such as microprocessor self-adapting electric spark processing, stainless steel welding, cold welding of cast iron, casting of one-piece hollow casings, shape adjustment by mechanical rolling, linear cutting of very thick workpieces, isothermal superplastic forming, sealing, spray-coating and deep refrigeration used in space manufacturing have been applied in various civilian industries. For example, by substituting titanium alloys for heat-resistant alloys and employing isothermal superplastic forming technology to make turbine disks for gas-turbine generators, efficiency can be improved 20 times, while cost can be cut by 90 per cent.

3. Technologies used in the non-destructive testing of composite materials

Non-destructive technologies for testing aerospace composite materials, including X-ray, ultra-sound, laser holography, acoustic emission and C-scanning, are gradually being extended to civilian use in areas in which composite materials are used.

III. EXTENDED USES OF SPACE MATERIALS, COMPONENTS AND PARTS

Space technology requires a wide variety of high quality materials, components and parts. This prompted China to pursue the development of its materials, electronics, machinery and other industries as early as the 1960s, and a majority of the products are currently being used in various industries. For example, microcrystalline glass developed in the early stages for launching vehicles can withstand high temperatures, is resistant to ablation, and has good radio-wave transmissivity. At present, this material is not only used in the aerospace industry, but is also used extensively in microwave ovens and electromagnetic stoves for civilian use. It is also used as substrate material for high-power microwave tubes and as casings for standard atomic frequency hydrogen clocks.

Ultra-thin molecular film, a new insulating material which is resistant to radiation, high temperature and corrosion, is now widely used in the electronics, electric cable and chemical industries.

As far back as the 1970s, composite materials were already widely used in the aerospace industry. They include carbon-fibre composites, glass-fibre composites, high silica-fibre composites, ceramic-based composites and three-directional carbon-carbon composites. Of these, carbon-fibre and glass-fibre composites are now widely used in civilian industries.

The gyroscope is a key component in aerospace control systems. Now also used in railway systems, it permits very quick and accurate detection of unevenness in railway tracks.

Development of solar batteries and nickel-cadmium batteries began in the 1960s. They were first used in the second satellite launched by China in 1971, and have been used in communication satellites and meteorological satellites. Since the 1980s, they have been mass-produced as civilian power-source products - for example, as an emergency source of power for public buildings. Furthermore, high-performance silver-zinc batteries used in launch vehicles and satellites are also being mass-produced as civilian power sources.

The servo-controlled valve used in launch vehicles has been widely used in machine tools, robots, rolling mill and material testing machines. Air bearings, sensors, flow meters, etc., that are used in rockets are also widely used in various industries. For example, an instrument for measuring changes in blood flow developed using static-pressure air bearings and non-contact sensor technology is now used in many hospitals.

CONCLUSION

For more than 30 years, China's space programme has followed the principle of self-reliance, with support from various industrial sectors in the country, and extending over many fields of technology. Spin-off benefits from the extended application of technological achievements to other areas are substantial. China is continuing to exploit further its advantages in this field, so that space technology can be extended and transferred to civilian industries more effectively and quickly. China's aerospace agencies wish to enhance exchange and cooperation with all friendly nations so that they can jointly contribute to the peaceful use of outer space by all mankind.

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WAYS AND MEANS OF MAINTAINING OUTER SPACE FOR PEACEFUL PURPOSES

STATUTE OF THE RUSSIAN SPACE AGENCY OF THE GOVERNMENT OF THE RUSSIAN FEDERATION

Working paper submitted by the Russian Federation

Following the establishment of the Russian Space Agency under the Government of the Russian Federation, and the assignment to it of the functions of implementing State policy in the area of the exploration and use of outer space, including in the international cooperation sector, the Russian delegation brings to the attention of the States members of the Committee on the Peaceful Uses of Outer Space the Statute of the Russian Space Agency (in an abbreviated version) approved by decree of the Government of the Russian Federation of 9 April 1992.

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Annex

STATUTE OF THE RUSSIAN SPACE AGENCY OF THE GOVERNMENT OF THE RUSSIAN FEDERATION

1. The Russian Space Agency of the Government of the Russian Federation (RSA) is a State administrative body which formulates and implements State policy on the exploration and use of outer space.

2. The main tasks of RSA are:

To implement State policy on the exploration and use of outer space;

To formulate, in conjunction with the Russian Academy of Sciences, the Unified Armed Forces of the Commonwealth of Independent States, and the ministries, departments and organizations concerned, and to submit to the Government of the Russian Federation the draft State space programme of the Russian Federation, specifying the financial and other resources required, and also the dates for the completion of activities;

To carry out general procurement for the development of space systems, complexes and scientific and industrial facilities envisaged under the State space programme;

To participate in the development and use of dual-purpose (military and civilian) space systems, complexes and resources developed under defence contracts in accordance with the State space programme, and also in the preparation and launching of space complexes for scientific and national economic purposes;

To develop, in conjunction with industrial organizations and enterprises, a scientific research and testing base for space activities, and to establish scientific and technical stocks for the development of rocket and space technology;

To cooperate with the relevant bodies of member States of the Commonwealth of Independent States and of foreign countries in the exploration and use of outer space, and also in the use of ground-based space facilities, within the limits of its competence;

To coordinate work on commercial space projects and promote their implementation;

To coordinate work on the preparation and conduct of manned space flights and the protection of the safety of cosmonauts.

3. The Russian Space Agency shall, in accordance with the tasks entrusted to it:

Organize, in conjunction with the ministries, departments and organizations concerned, systems research to support the main areas of the development of space technology for scientific and industrial purposes and to determine the tactical and technical characteristics of space complexes;

Prepare on the basis of the State space programme and submit to the Government of the Russian Federation proposals on the Agency's budget for the following year;

Formulate in conjunction with the Russian Academy of Sciences and the ministries, departments and organizations concerned, on the basis of the State space programme and in accordance with its budget, and submit to the Government of the Russian Federation a draft programme of work in the Russian Federation for the following year;

Participate in the organization and conduct of scientific research, experimental and design and construction work on the development and use of dual-purpose space technology, and also of work to maintain and develop ground-based space facilities infrastructure;

Carry out scientific research, experimental and design and construction work on space technology for scientific and industrial purposes, procure supplies and organize the use of individual types of this technology in accordance with the Russian Federation's space technology work programme for the following year (space vehicles developed for the purposes of the Ministry of Communications of the Russian Federation and the Ministry of Ecology and Natural Resources of the Russian Federation shall, as a rule, be procured and operated by these ministries);

Ensure the continuing development of new technologies, materials and scientific and technical stocks in order to develop promising types of space technology;

Maintain and develop the experimental and testing base needed to develop space technology under ground conditions;

Carry out research, scientific and technical monitoring and organization of work on the use, as a means for launching various space devices, of strategic missile systems which are scheduled for reduction or elimination;

- Cooperate with the corresponding organs of the member States of the Commonwealth and the Unified Armed Forces of the Commonwealth of Independent States in aspects of the conduct of joint space activities, the use of ground-based space facilities and the implementation of the other provisions of the inter-State agreement on joint activities in the study and utilization of outer space;

- Ensure, in conjunction with the ministries and departments concerned, compliance with the international obligations of the Russian Federation in the field of space activities and the development of mutually

advantageous cooperation with government and commercial organizations of foreign countries;

- Conduct, in conjunction with the Ministry of Foreign Affairs of the Russian Federation and the other ministries and departments concerned, discussions on the conclusion of international agreements for the exploration and use of outer space;

- Conclude, within the limits of its competence, international agreements with the corresponding organizations of foreign States;

- Maintain a register of space objects of the Russian Federation and submit information to the United Nations on space objects launched by the Russian Federation;

- Conduct, in accordance with established procedures, the issue of licences for all types of activity in the exploration and use of outer space and the provision of space services in the Russian Federation, and keep a record of those licences;

- Participate in the preparation of standards relating to the manufacture and use of space technology;

- Participate in monitoring compliance with safety requirements, standards and regulatory documents in the manufacture, testing and use of civilian space technology;

- Organize information services for the public, and take part in exhibitions of rocket and space technology and in the preparation and publication of scientific and technical literature on space activities;

- Elaborate, in conjunction with the ministries and departments concerned, draft legislative and other regulatory acts governing activities in the exploration and use of outer space.

4. The Russian Space Agency shall have the right:

- To acquire, lease, install, reconstruct and operate space and other forms of technology (including space vehicles and carrier-rockets), buildings and installations and other property and to acquire patents, licences and know-how;

- To conclude, on the basis of the space technology programme of the Russian Federation for the given year and in accordance with the regime established by the legislation of the Russian Federation, contracts for the conduct of basic, experimental and design studies, scientific research and work on the application of technology with ministries, departments, organizations and enterprises operating in the territory of the Russian Federation and of other States and to use extrabudgetary resources for the financing of such studies;

- To be represented, in accordance with its competence, in international organizations active in the exploration and use of outer space;

- To engage the services of experts on a contractual basis for the purpose of consultations or the preparation and consideration of relevant issues, and to set up temporary task forces and working groups;

- To engage in foreign economic activity in accordance with the established legal procedures;

- To send, in accordance with established procedures, employees of the Agency on official visits to foreign countries and to receive foreign specialists at the Agency to deal with issues connected with the Agency's work;

- To arrange the admission of foreign specialists, to launching sites and other ground-based space facilities, by agreement with the Office of the Chief of Space Resources of the Unified Armed Forces of the Commonwealth of Independent States and the corresponding organs of the member States of the Commonwealth;

- To engage, in accordance with established procedures, in international telephone, telex and facsimile communications.

5. The Russian Space Agency shall be headed by a General Director, who shall be appointed and dismissed by the President of the Russian Federation.

6. The General Director of the Russian Space Agency shall have deputies, appointed on his recommendation by the Government of the Russian Federation.

7. The Russian Space Agency shall operate settlement, current and budget accounts in banks, including foreign currency accounts.

8. The Russian Space Agency shall be a juridical person and shall have a seal depicting the state emblem of the Russian Federation and its own name, as well as the emblem (logo) of the Agency.